

Serial No.: 10/750,492

Examiner: A. Bhat

Title: METHOD AND APPARATUS FOR MACHINE VECTOR LOOP EXTRACTION

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Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (Currently Amended) A method for determining a one-dimensional gap stack-up for a gap within an assembly of parts, the method comprising:

identifying a gap for stack-up analysis;

identifying a first surface and a second surface defining the gap, wherein a first part of the assembly of parts comprises the first surface and a second part of the assembly of parts comprises the second surface; and

determining a vector loop comprising a plurality of elements from the first surface through the assembly of parts to the second surface, wherein the plurality of elements comprise the gap stack-up;

determining at least one of a dimension and a tolerance for each one of the plurality of elements; and

providing a list of each one of the plurality of elements and the at least one of the dimension and the tolerance associated therewith in a spreadsheet format to allow correction of tolerance values associated with an out-of-tolerance gap prior to completing the assembly of parts.

2. (Original) The method of claim 1 wherein the vector loop comprises vector loop segments, and wherein the step of determining the vector loop further comprises determining the vector loop segments between geometric planes of the assembly of parts for which a normal to the plane is collinear with the vector loop.

3. (Original) The method of claim 2 wherein the geometric planes comprise geometric planes between two parts of the assembly of parts.

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4. (Original) The method of claim 2 wherein the geometric planes comprise geometric planes within a part of the assembly of parts.

5. (Original) The method of claim 1 wherein the vector loop comprises vector loop segments, and wherein a dimension is associated with each vector loop segment, and wherein the method further comprises combining the dimension associated with each of the vector loop segments to determine a gap stack-up dimension.

6. (Original) The method of claim 5 wherein the step of combining further comprises multiplying each dimension by a weight and summing the resulting products.

7. (Original) The method of claim 6 wherein the weight comprises a numerical value indicating the relationship between a change in the dimension of a vector loop segment and a change in the gap stack-up dimension.

8. (Original) The method of claim 7 wherein the weight comprises a +1 or a -1, and wherein the +1 weight indicates a direct relationship between the change in the dimension of the vector loop segment and the change in the gap stack-up dimension, and wherein a -1 weight indicates an inverse relationship between the change in the dimension of the vector loop segment and the change in the gap stack-up dimension.

9. (Original) The method of claim 6 wherein the weight comprises a numerical value indicating the relationship between a change in a dimension of a vector loop segment caused by a change in an environmental condition to which the assembly of parts is subjected and a change in the gap stack-up dimension resulting from the change in the environmental condition.

10. (Original) The method of claim 9 wherein the change in the environmental condition comprises a thermal environmental change.

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11. (Original) The method of claim 1 further comprising providing a three-dimensional representation of the assembly of parts, wherein the step of identifying the gap further comprising identifying the gap from the three-dimensional representation.

12. (Original) The method of claim 1 further comprising providing a three-dimensional representation of the assembly of parts, wherein the step of identifying the first and the second surfaces further comprises identifying the first and the second surfaces from the three-dimensional representation.

13. (Original) The method of claim 12 further comprising superimposing a representation of the vector loop on the three-dimensional representation of the assembly of parts.

14. (Original) The method of claim 12 wherein the three-dimensional representation comprises a representation provided by a computer-aided design system.

15. (Original) The method of claim 1 wherein the step of determining the vector loop further comprises determining a plurality of dimensions in the vector loop between the first surface and the second surface.

16. (Original) The method of claim 15 wherein each of the plurality of dimensions includes an associated tolerance.

17. (Original) The method of claim 16 further comprising combining the tolerances to determine the gap tolerance.

18. (Original) The method of claim 17 wherein the step of combining further comprises summing the tolerances.

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19. (Original) The method of claim 17 wherein the step of combining further comprises:

determining a relationship between each tolerance and a standard deviation for the dimension with which the tolerance is associated;

determining the standard deviation for each dimension; and

determining the standard deviation of the gap according to the root sum of the squares of the standard deviation.

20. (Original) The method of claim 19 wherein the relationship between the tolerance and a standard deviation for the dimension comprises the standard deviation = tolerance/3.

21. (Canceled)

22. (Currently Amended) The method of claim [[21]]¹ further comprising determining at least one of the gap dimension and the gap tolerance by combining the respective dimension and tolerance of each one of the plurality of elements; and

providing the gap tolerance and the gap dimension in the spreadsheet format.

23. (Original) The method of claim 1 wherein the vector loop comprises vector loop segments, and wherein one or more of the vector loop segments comprises a mating pin and hole, wherein an axis of the pin and hole combination is perpendicular to the vector loop.

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24. (Currently Amended) A method for determining a vector loop within an assembly of parts, comprising:

(a) identifying a loop from-face of a first part and a loop to-face of a second part of the assembly of parts, wherein the vector loop extends therebetween; and

(b) identifying parts in contact at a contact face within the assembly of parts, wherein a normal to the contact face is collinear with the vector loop, and wherein each identified part comprises a part from-face and a part to-face, and wherein the vector loop extends from the loop from-face of the first part, through the from-face and the to-face of each succeeding part in contact at the contact face, to the loop to-face of the second part; and

(c) for each part identified in the step (b), determining at least one of a dimension and a tolerance between the loop from-face and the loop to-face to allow correction of tolerance values associated with an out-of-tolerance gap prior to completing the assembly of parts.

25. (Canceled)

26. (Original) The method of claim 24 wherein the step (b) further comprises:

(b1) determining all parts within the assembly of parts;

(b2) determining adjacent parts in contact at a contact face, wherein a normal to a contact face is collinear with the vector loop;

(b3) beginning with the loop to-face of the second part, traversing the contact faces determined at the step (b2) back to the loop from-face of the first part, wherein each part encountered during traversal is entered at the part from-face and exited at the part to-face; and

(b4) determining at least one of the dimension and the tolerance between the part from-face and the part to-face for each part encountered at the step (b3).

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27. (Original) The method of claim 26 wherein the step (b4) further comprises:

(b4.1) determining all faces of the part wherein a normal to the face is collinear with the vector loop; and

(b4.2) determining from among the faces determined at the step (b4.1) at least one of the dimension and tolerance that contributes to the dimension or the tolerance between the part to-face and the part from-face.

28. (Original) A computer program product for performing a one-dimensional gap stack-up for a gap within an assembly of parts, the computer program product comprising:

a storage medium readable by a computer processor and storing program code for execution by the computer processor, the program code comprising:

a program code module for identifying a gap for stack-up analysis;

a program code module for identifying a first surface and a second surface defining the gap, wherein a first part of the assembly of parts comprises the first surface and a second part of the assembly of parts comprises the second surface; and

a program code module for determining a vector loop comprising a plurality of elements from the first surface through the assembly of parts to the second surface, wherein the plurality of elements comprise the gap stack-up.

29. (Original) The computer program product of claim 28 further comprising a program code module for identifying at least one of a dimension and a tolerance for each one of the plurality of elements.

30. (Original) The computer program product of claim 29 further comprising a program code module for determining at least one of a mean gap dimension and a standard deviation of the mean dimension in response to the respective dimension and tolerance for each one of the plurality of elements.